men; to obtain better material for the making of teachers; to educate them thoroughly in the spirit and matter of some one subject or limited group of subjects, and to leave them free to develop their own methods, judging them only by their results. This is what the universities have done with such signal success, what the colleges are now doing and what the schools must do if they are to advance. It is not methods that teach, but men and women. The second is toward the establishment of thorough and continuous courses in Nature Study through all grades from the kindergarten to the high school. There are two reasons for this from our present point of view. Thus only can students acquire a knowledge of the more obvious facts and phenomena of Animal and Plant life, Physical Geography, Physics and Chemistry so valuable as a basis for the systematic study of some one of the sciences in the high school. But, far more important than this is the use of Nature Study to preserve the natural inductive facilities of children unimpaired through school life, not to speak of improving these facuties through training. No fact about our later and better courses of elementary botanical study is more striking than the unanimity with which they begin with exercises adapted to train observation, comparison, etc.—in a word, induction. Now, these are powers that children possess naturally, the most universal of human faculties, those by which new knowledge is won; those by which self-made men succeed; those which surely above everything education ought to cherish and develop. But, as a matter of fact, these faculties somewhere between the primary and high school are so effectually throttled out of nine-tenths of our students that the first need of the high-school or college teacher is to redevelop them. This suppression is, of course, the result of excessive text-book and deductive work, which always tends to make students distrustful of their own powers and leads them to regard as the only real sources of knowledge the thoughts of others properly recorded in printed books. Thorough and properly taught Nature Study is, in my opinion, the first need in all education to-day.

Third of the tendencies I have mentioned is this: The movement among the colleges to require, or at least accept, some one thoroughly-taught science for entrance, amongst which botany is always included. This will compel preparatory schools to improve their teaching, for the science offered must be enough in quantity and quality to allow students to omit the elementary course in the college and enter upon second courses. Moreover, this movement will allow college teachers to exert more influence than ever upon school teaching, for, controlling admission, they can state which topics are to be studied and what general methods are to be followed. A great part of the value to botanical teaching of this movement will, however, be lost, unless, in the very near future, the colleges, through their proper representatives, agree upon approximately-equivalent requirements, so that the preparatory schools may not be distracted and weakened by widely-differing demands.

Though botanists are thus eagerly striving to promote the interests of their science, it is not their desire unduly to magnify its importance, but only to give it its proper place in education and among the sciences. Their aim, I believe, may be thus expressed: Let education advance; let science advance; let botany advance.

W. F. Ganong.
Smith College, Northampton, Mass.

ELEVENTH ANNUAL MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA, DECEMBER 28TH, 29TH AND 30TH, NEW YORK.

I.

The Geological Society of America completed the first year of its second decade with

the eleventh annual meeting at Columbia University, December 28th. Just nine years had elapsed since its last session in New York, which was held at the American Museum of Natural History. The Society assembled this year at 10 a. m., on Wednesday, the 28th, in the large lecture room of Schermerhorn Hall; Professor J. J. Stevenson, the retiring President, in the chair. President Low was introduced and in a few happily chosen remarks welcomed the Society to Columbia. After the usual routine business, President Stevenson read a memorial of the late Professor James Hall, so long State Geologist of New York and the first President of the Society. At the conclusion of the memorial Professor Stevenson delivered his presidential address upon the subject 'Our Society.' He sketched the rise and development of geological organizations in North America and discussed the important influence that they have exercised in the material progress of the country. The address appeared in full in the last number of SCIENCE.

The reading of papers was at once begun, as a list of fifty titles had accumulated.

The Archæan-Potsdam Contact in the Vicinity of Manitou, Colorado. W. O. CROSBY, Boston, Mass.

THE speaker described the remarkably plane character of the contact of the Archæan granite and Potsdam sandstone, which is in striking contrast with the existing topography of the granite even in coastal regions. He distinguished and described in detail, with numerous illustrations, the original and secondary irregularities, the latter including a few flexures and numerous small faults which throw important light upon the origin of the sandstone dikes of the Manitou district. The original irregularities of the contact are all small, and, as a rule, are evidently related to the existence in the Archæan granite of a coarse concentric or spheroidal structure. The plane type of erosion-unconformity, although probably of rather widespread and common occurrence, appears to have attracted less attention than it merits. It suggests interesting possibilities as regards the development of peneplain surfaces in early times and invites a renewed comparison of the relative efficiency in base-leveling of subaerial and marine agencies. These more theoretical aspects of the subject were embraced within the scope of the paper, and the general conclusion was that the Archæan land surface must have passed with extreme slowness beneath the waves of the Potsdam sea.

The paper was illustrated with maps and lantern slides and excited great interest, but did not arouse discussion.

Outline of the Geology of Hudson's Bay and Strait. ROBERT BELL, Ottawa, Canada.

THE author described the general nature of the depression of Hudson's Bay; the contrasted characters of the opposite shores; the Huronian areas on both sides; the Intermediate Formation; the Animikie and Nipigon series; the Trenton group in Hudson's Bay and Strait; the middle Silurian rocks on the east, west and north sides of the Bay and in Baffinland; the large Devonian area southwest of James Bay; the Devonian rocks on Southampton Island; and the geology of the islands in the Bay. He gave a general geological description of Hudson's Strait and of the rocks of its north shore, or southern Baffinland. He also took up the Laurentian and older Cambrian strata of the Ungava district. Under the head of the economic minerals of the regions described, some details of the rich iron-ore deposits, involving carbonates, hematites and magnetites, were presented. In connection with the glacial geology of Hudson's Bay and Strait he sought to show the source of the ice that had yielded the

scratches and its direction of movement. The Quaternary deposits and the question as to the rate of elevation of the land received somewhat extended discussion. The author believes in the recognizable elevation within the historic period and briefly adduced the phenomena on which he based his conclusion.

In discussion B. K. Emerson stated that he was somewhat familiar with the rocks of the region from the collections of the Hall and Kane expeditions which are deposited at Amherst, and from others gathered years ago by English officers. In the latter were fossils of the Utica epoch. J. B. Tyrrell opposed the idea of the recent rise in the west shore of Hudson's Bay, basing his argument upon an old map of the region about Fort Churchill which showed relations like the present ones. David White inquired about the presence of lower Silurian rocks about Frobisher's Bay, and mentioned fossils of the Trenton period which had been identified by Schuchert. H. S. Williams asked if no strata above the Devonian were known. In reply, Dr. Bell again upheld the view that the land was rising and mentioned many arguments in support of it. The Trenton fossils, he said, had come from the northwest in the drift, and that no Carboniferous or later rocks, except Pleistocene, were known.

The Society then adjourned for lunch, and at the afternoon session begun at once the reading and discussion of papers.

The Faunas of the Upper Ordovician in the Lake Champlain Valley. Theodore G. White, New York City.

The results of a detailed study of the consecutive faunas contained in each stratum at numerous localities throughout the length of the valley were presented after a preliminary description of the general geology. A complete section is afforded from the base of the Black River formation through the Trenton and terminating in the Utica. Species hitherto reported only from Canadian localities are found associated with those characteristic of the Trenton Falls type-province, showing the Champlain connection with Ordovician seas. Several zones characterized by restricted species are located, and also 'Conglomeratic zones.' The fauna is very abundant and supplies a basis of comparison for similar detailed study from other provinces. The occurrence of the Hudson River and Oneida groups in the region is questioned.

In discussion H. M. Seely spoke of the attractiveness of the region and of its interesting problems and of the need of close paleontological study of the faunas. H. P. Cushing spoke in the same strain, and H. M. Ami remarked the close relationships of the faunas with those of Canada. C. S. Prosser remarked the resemblances and the contrasts with those of the Mohawk Valley.

The Newark System in New York and New Jersey. Henry B. Kummel, Chicago, Ill.

The paper presented a general summary of the petrology, stratigraphy and conditions of origin of the Newark rocks in New York and New Jersey. The rocks form a northwestward dipping monocline, interrupted by gentle folds and many faults, two of which have a throw of several thousand feet. The lithological character varies greatly, so that sub-divisions established in one area do not hold for the entire field, and yet sub-divisions based on lithological characteristics are the only ones possible. The author classified them into the Stockton, the Lockatong and the Brunswick formations, together with the traps. Both extrusive and intrusive trap sheets occur and their relations to the sedimentary beds are instructive. The question of thickness is complicated by the faulting. Estimates vary from 12,000 to 15,000 feet. The strata were probably accumulated under estuarine con-

ditions in shallow water. The surrounding land areas seem to have been reduced nearly to base-level and deeply covered with residuary materials immediately preceding the deposition of these beds, but during their deposition subsidence of the estuary and elevation of the surrounding areas was in progress. The paper was illustrated by lantern slides.

In discussion B. K. Emerson brought out many points of resemblance with the Juratrias strata of the Connecticut Valley and N. S. Shaler compared them with those of the Richmond, Va., basin. He argued against their marine origin and in favor of lakes either salt or fresh. A. Heilprin spoke of the fishes which were considered as probably marine by Cope, but N. S. Shaler stated in reply that near Richmond the fish were found in association with vegetable remains. No definite view was reached on this point, although B. K. Emerson remarked that the casts of salt crystals were often seen in the shales in New England. I. C. Russell raised the point of the former extension of the Newark strata of New Jersey to the eastward, but the author had no light to throw on the question. J. E. Wolff and J. F. Kemp discussed the distribution of the boulders from the trap and its contacts over New York City and Long Island.

Discovery of Fossil Fish in the Jurassic of the Black Hills. N. H. DARTON, Washington, D. C.

THE speaker exhibited several specimens of the recently discovered fossil fish and described their occurrence in the Jurassic beds on the confines of the Black Hills. The fish are now being investigated by specialists. The paper was immediately followed by the next one.

Mesozoic Stratigraphy in the Southeastern Black Hills. N. H. DARTON, Washington, D. C.

THE author exhibited a diagram of details of stratigraphy determined in 1898. The investigation resulted in the discovery of marine Jurassic in the southern Black Hills, and of an horizon of large vertebrates in the lower Cretaceous. The paper was beautifully illustrated by lantern slides, and on its conclusion the Society adjourned until the following day.

In the evening the Fellows attended the reception, which was most hospitably extended to the visiting scientific societies by the authorities of the American Museum, and listened with great interest to the addresses of Mr. Morris K. Jesup and Professor Henry F. Osborn. They also attended the reception given by Professor Osborn, at his residence, at the close of the lecture.

On reassembling Thursday morning the reading of papers was at once resumed, the following two contributions being presented together:

Relations of Tertiary Formations in the Western Nebraska Regions. N. H. DARTON, Washington, D. C.

THIS paper presented the results of several seasons' investigations of the White River and the Loup Fork formations, extending from the South Platte River into the Bad Lands of South Dakota.

Shorelines of Tertiary Lakes on the Slopes of the Black Hills. N. H. Darton, Washington, D. C.

DURING the season of 1898 the author discovered extensive and beautiful shorelines and deposits of the Tertiary lakes far up the slopes of the Black Hills. They throw interesting light on certain stages of physiographic development of the Black Hills and the origin and condition of deposition of some of the White River sediments.

No discussion resulted.

General Geology of the Cascade Mountains in Northern Washington. ISRAEL C. RUSSELL, Ann Arbor, Mich.

The region under discussion covers an area from the Northern Pacific Railroad to the Canadian boundary, sixty miles east and west by one hundred and twenty north and south. The following topics were taken up: Terranes—A. *Eruptive*, general absence of basalt, the schists, granites and gneisses, greenstones, andesite of Glacier Peak, volcanic tuff and dust, acid and basic dikes, the source of the Columbia lava. B. *Sedimentary*, *Pretertiary*, *i. e.*, Carboniferous and Triassic strata, including the Similkameen system and the Ventura system. C. *Tertiary* strata, including Snoqualame slate, Winthrop sandstone, Camus sandstone, Swank sandstone, Roslyn sandstone, Ellensburg sandstone. Abundance of fossil leaves. D. *Pleistocene* strata, moraines and valley gravels.

Structural Geology.—Domes, including the Cascade dome, the Wenatchee dome. Folds and faults. *Physiography:* The Cascade peneplain, the Cascade plateau, dissection of the Cascade plateau. Mature topography. Low-grade valleys.

Ancient Glaciers.—On the east side of the Cascades: Yakima glacier, Wenatchee mountain glacier, Icicle glacier, Wenatchee, Chelan, Methow, Okanogan glaciers. On the west side of the Cascades: Sauk glacier, Skagit glacier, confluent ice sheet. Absence of northern drift. Gravel deposits.

Terraces.—Great terraces of the Columbia, the Snake and Spokane, due to climatic changes. No evidence of recent submergence; absence of white silt.

Existing Glaciers of the Wenatchee mountains and the Cascades.

Climate.—The rainy western slope with dense forests and the dryer eastern slope with open forests and grass.

Economic Geology.—Coal, gold, copper, iron, building stone, clays, etc.

In discussion Bailey Willis expressed doubts as to the divisibility of the Tertiary sandstones into so many distinct members, believing that combination would be necessary. He also argued that the domes were due to cross-folding rather than to laccolithic uplift, as urged by Russell. S. F. Emmons suggested lava dams as the cause of the terraces rather than submergence or change of climate. G. M. Dawson said that the white silt was not to be expected in the region under discussion and favored submergence and glacial ice as the causes of the terraces. In reply I. C. Russell stated that the lava flows were older than the terraces, as the terrace gravels were present in cañons cut in the lava. He admitted that Willis's views regarding the sandstones and the uplifts might prove correct and that the causes of the terraces was obscure.

The Society then adjourned for lunch. On reassembling the subject-matter of W J McGee's paper was introduced by W. H. Holmes. Holmes described the discovery of bones and artefacts on the surface in the vicinity of the California gravels that had yielded buried skulls and implements, and detailed the stories of old residents regarding the large part that practical jokes played in the discovery of the remains. He illustrated the geology of the Table Mountain region by sections, and developed the general argument that the relics were those of Digger Indians, who are still in residence,or were within the period of the gold miners. He was followed by W J McGee before discussion opened.

Geology and Archæology of the California Gold Belt. W J McGee, Washington, D. C.

In continuing the paper of Holmes the speaker sketched the geological history of the Western Sierras, emphasizing the Tertiary age of the gravels, the ancient drainage; the inflow of tuffs and lavas; the subsequent erosion of the present steep river cañons to a depth of 2,000 feet. He stated that in this time the fauna and flora had

entirely changed, no species, and, so far as he knew, no genus lasting through to the present except that most variable of all genera, *Homo*, and the species most sensitive of all, to physical changes, *sapiens*. Not only this, but the relics were those of the men, the Digger Indians, living there today, and when not bones the objects were those connected with the acorn industry of the present tribes. From all these considerations a sweeping argument supporting the general improbability of the geological antiquity of the remains was adduced.

In discussion W. H. Brewer spoke of the circumstances under which the discovery of the Calaveras skull was made, he having been at the time on the California Geological Survey. He described its fossilized condition and its contained cemented gravels and stated his belief in its very considerable age even if not Tertiary. He also gave an interesting account of the great theological and ecclesiastical opposition to Professor Whitney that the announcement of the geological age of the skull aroused, amounting almost to persecution. The discovery came shortly after the publication of Darwin's views on the descent of man and in the midst of the excitement that these views aroused.

Major Powell recounted a number of his experiences with discovered relics and the tendency of collectors to palm off modern things as antiquities either in joke or as a fraud. He emphasized the need of depending absolutely on geologists for all reliable testimony as to authentic occurrences in sedimentary deposits. J. A. Holmes spoke in support of the Major's view and related the recently recorded discovery of implements in marl pits and Eocene limestone in North Carolina, the same being attested by affidavits of reputable citizens.

Geology of the Lake Region of Central America.

C. WILLARD HAYES, Washington, D. C.

THE speaker discussed the following topics, illustrating his remarks by a fine map. His data had been accumulated while in the service of the Nicaragua Canal Commission and especially from test borings: *Introduction:* general relations of the country under discussion. *Topography:* the coastal plain; the Chontales hills; the Tola hills; the Costa Rican volcanic range; the Nicaraguan volcanic range; the Jinotepe plateau; the lake basin; the Rivas plain. *Climate:* the eastern section of heavy rainfall and dense forests; the western of lighter rainfall and savannahs. *Rock formations:* Tertiary sediments including the older Brito formation and the later Machuca formation; Tertiary igneous rocks, dacites, andesites, basalts, volcanic breccias and conglomerates; recent sediments, alluvium; recent igneous rocks, trachytes, basalts, tuffs and pumice. *The Regolith:* the conditions favor rock decay; the great depth of weathering; red and blue residual clays; concerning weathering in igneous and sedimentary rocks. *Recent geologic history of the region*: early Tertiary deposition; Tertiary erosion; late Tertiary and post-Tertiary uplift and dissection of uplands; recent submergence and alluviation; recent volcanic activity; formation of lakes and shift of divide to westward. *Characteristics of San Juan Valley:* the upperflood-plain; the Castillo-Ochoa gorge; the lower flood-plain.

The paper aroused the liveliest interest from the great importance of the project of the international canal. J. E. Wolff asked about the nature of the rock decay and whether silica, the alkaline bases and iron were removed, leaving beauxite, or whether hydrated silicates resulted. Mr. Hayes replied that he thought the latter, but that no analyses had yet been made of his many samples. Inquiries were raised about the recency of the volcanic outbreaks and the nature of the lava. The reply was that the lava was basalt and the last outbreak about fifteen years ago.

An Unrecognized Process in Glacial Erosion. Willard D. Johnson, Washington, D. C.

The glacial topography of mountains was analyzed, and the more distinctive forms discriminated from those of aqueous erosion. The recognized process, that of scour, its action downward and forward with the glacial advance, was described. Glacial scour and aqueous erosion were regarded as alike incompetent to bring about the results and as a rule inimical to the production of known forms. An unrecognized process was set forth, that of sapping, whose action is horizontal and backward. The tendency of glacial scour is to produce sweeping curves and eventually a graded slope. The tendency of the sapping process is to produce benches and cliffs. Sapping is altogether dominant over scour. Under varying conditions, however, its developing forms become obsolescent; their modification, then, by rounding off of angles, puts them seemingly into the category of scour forms. An hypothesis was advanced as to the cause of glacial sapping. The ultimate effect is truncation at the lower level of glacial generation. A second analysis and a more appreciative classification of transition types terminated the paper.

Before discussion the next paper was read because it dealt with allied phenomena. The hour, however, being late, the discussion went over till the next day.

Geology of the Yosemite National Park. H. W. Turner, Washington, D. C.

By means of lantern slides the author illustrated the topography of the granite areas in the high Sierras and the Yosemite and other allied gorges. He developed the view that joints had chiefly caused the precipitous cliffs, and concentric shelling off, the domes. Minor forms were also explained. He opposed the view that faulting had caused the gorges.

Gold Mining in the Klondike District. J. B. Tyrrell, Ottawa, Ont.

By means of a fine series of lantern slides the author illustrated the geographical situation and the geology of the Klondike gold-bearing gravels. The stream gravels are the usual type of placers, but the bench gravels are small lateral moraines left by glaciers. The gold has not been derived from any distance.

The Nashua Valley Glacial Lake. W. O. Crosby, Boston, Mass.

By means of lantern slides from photographs and from maps and profiles based on bore-holes made by the officials of the Boston department of municipal water supply, the speaker described the bed-rock surface, the overlying gravels on the Nashua River, and the characters of the old glacial lake of whose former existence they gave evidence.

On the conclusion of the paper, at 5:45 p. m., the Society adjourned until the following day. In the evening about one hundred Fellows, many with their wives, gathered at the Hotel Logerot for the annual dinner. Under the presiding oversight of Professor B. K. Emerson, the past grand master of all the toastmasters, another enjoyable gathering was added to the list of those previously held.

J. F. Kemp.

Columbia University.

(To be Concluded.)

SCIENTIFIC BOOKS.

Theory of Groups of Finite Order. By W. Burnside, M.A., F.R.S., Professor of Mathematics at the Royal Naval College, Greenwich. Cambridge, The University Press. 1897. 8vo. Pp. xvi+388. Price, $3.75.

If, assuming a single but elevated point of view, we describe mathematics as the science of formal law, then the theory of operations easily commands the field, for it is the quintessence of mathematical form, the comparative anatomy,